GEC06-2006-000033

Abstract for an Invited Paper
for the GEC06 Meeting of
the American Physical Society

Energy transport and instabilities in high pressure plasmas[1]

JOACHIM HEBERLEIN, University of Mineesota

While electric arc plasmas can be considered to be in local thermal equilibrium, any interaction of the arc with its surroundings will result in a non-equilibrium boundary layer. Two such non-equilibrium boundary layers will be considered. One is the interaction of an arc with a solid surface, i.e. what happens to the energy and current transfer if you have extremely steep gradients, and when diffusion processes dominate. Contradictory evidence and theories exist for such a situation. Recent Langmuir probe and Thomson scattering measurements have provided some insight and support qualitatively some previous modeling predictions. However, it may be questioned if a continuum approach is still valid when temperature gradients of 10^5 K/mm exist. The other boundary layer is encountered when a high velocity plasma jet is surrounded by a cold gas. The steep gradients in density and viscosity between the plasma jet and its surroundings result in fluid dynamic instabilities, enhanced by upstream arc instabilities. These instabilities result in entrainment of cold surrounding gas in form of larger bubbles, requiring a description of a jet consisting of two immiscible fluids. Approaches will be described for controlling these instabilities for an application like plasma spraying where the residence time of the particles is in the same order of magnitude as the period of the instability.

[1]Acknowledgment: support by NSF CTS 0225962 and CTS 0317429.